The medical records were reviewed retrospectively for 856 cases. A total of 66 cases of ASD were enrolled. On preop magnetic resonance imaging, disc degeneration was measured at the upper and lower parts of surgically treated levels and confirmed by the commonly used Pfirrmann grading system. Segmental flexibility in sagittal plane was embodied in segment range of motion (ROM) obtained through flexion and extension X-ray before surgery. Coronal angle was recorded as methods Cobb's angle including fusion levels preoperatively. For the comparison of categorical variables between two independent groups, the chi-square test and Fisher exact test were performed.

Proximal ASD and distal ASD were 37/856 (4.32%) and 29/856 (3.39%), respectively. The incidence of proximal ASD was relatively high but insignificant differences. In comparison between ASD group and non ASD group, proximal Pfirmman was higher in proximal ASD and distal Pfirmman was higher in distal ASD group ($p=0.005$, $p<0.008$, respectively). However, in the ROM, proximal ROM was higher in proximal ASD, but distal ROM was not different between the two groups ($p<0.0001$, $p=0.995$, respectively). Coronal angle was not quite different in both groups ($p=0.846$).

In spite of higher frequency in ASD in proximal level in spinal fusion, it is not clear that incidence of ASD in proximal level is not higher than that of distal ASD group in more than 2 level thoracolumbar fusions. Not only Pfirrmann grade but also proximal segmental ROM is risk factor for predicting the occurrence of ASD in patients more than 2 level of thoracolumbar spine fusion operation excluding L5S1 [1)].

2016

Among 510 patients who underwent posterior lumbar fusion for degenerative lumbar disease between January 2009 and October 2009, a total of 50 patients with ASD after surgery were selected. Another group of 50 matched patients with degenerative lumbar disease without ASD after spinal fusion were selected as the control group. Each patient in the ASD group was matched with a control patient according to age, sex, fusion level, and follow-up period.

The risk factors considered were higher BMI, pre-operative adjacent segment disc and facet degeneration, and pre-operative paraspinal muscle atrophy and fatty degeneration. The radiographic data were compared between the ASD and control groups, to determine the predictive factors of adjacent segment degeneration after posterior lumbar fusion by using logistic regression analysis. The study was not externally funded. The authors have no conflict of interest to declare.

Multivariate logistic regression analysis indicated that higher BMI (OR: 1.353, $p = 0.008$), preoperative facet degeneration on computed tomography (CT) examination (OR: 3.075, $p = 0.011$), disc degeneration on magnetic resonance imaging (MRI) (OR: 2.783, $p = 0.003$), fatty degeneration (OR: 1.080, $p=0.044$), and a smaller relative cross sectional area (CSA) of the paraspinal muscle preoperatively (OR: 0.083, $p = 0.003$) were significant factors for predicting the development of ASD.

The occurrence of radiologic ASD is most likely multifactorial, and is associated with a higher BMI, pre-existing facet and disc degeneration on preoperative examination, and a smaller pre-operative relative CSA of the paraspinal muscle on MRI [2)].

A retrospective study evaluated 1250 consecutive patients who underwent posterior lumbar fusion and pedicular fixation between February 2006 and February 2009. A total of 13 patients with symptomatic ASD (clinical ASD) who underwent secondary surgery were identified. Another group of 22 patients without symptomatic ASD (subclinical ASD) after spinal fusion were marked as the control

group. These two groups were compared for demographic data and clinical and radiographic features to investigate the possible predictive factors of symptomatic ASD.

The overall incidence rate of symptomatic ASD was 1.04%. Radiographic risk factors for the development of a symptomatic ASD were increased sagittal balance, loss of lordosis, and adjacent disc space collapse. In the clinical ASD group, by multivariate logistic regression analysis, demonstrated that BMI, preoperative ADD on MRI and disc bulge maintained their significance in predicting likelihood of clinical ASD.

Patients with increased BMI, preoperative ADD and disc bulge on MRI have a statistically significant increased risk of developing symptomatic ASD [3].

2014

A consecutive series of 490 patients who had undergone lumbar spinal fusion of 3 or fewer segments to treat degenerative lumbar spine disorder was identified. The mean age at index operation was 53 years, and the mean follow-up period was 51 months (12-236 mo). The number of patients treated by PLF and PLIF were 103 and 387, respectively. The incidence and prevalence of revision surgery for ASD were calculated by Kaplan-Meier method. For risk factor analysis, they used log-rank test and Cox regression analysis with fusion methods, sex, age, number of fused segments, and presence of laminectomy adjacent to index fusion.

After index spinal fusion, 23 patients (4.7%) had undergone additional surgery for ASD. Kaplan-Meier analysis predicted a disease-free survival rate of adjacent segments in 94.2% of patients at 5 years and 89.6% at 10 years after the index operation. In the analysis of risk factors, PLIF was associated with 3.4 times higher incidence of ASD requiring surgery than PLF ($P = 0.037$). Patients older than 60 years at the time of index operation were 2.5 times more likely to undergo revision operation than those younger than 60 years ($P = 0.038$). There were no significant differences in survival rates of the adjacent segment according to sex, preoperative diagnosis, number of fused segments, and concomitant lumbar laminectomy to adjacent segment.

It was predicted that 10% of patients would undergo additional surgery for treating ASD within 10 years after index lumbar fusion. In this study, PLIF showed higher incidence of ASD than did PLF. Patient age greater than 60 years was another independent risk factor. Surgeons should carefully consider these factors at the time of surgical planning of lumbar fusion [4].

1)
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